National Renewable Energy Laboratory

NREL North American Solar Radiation Atlas

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Operated for the U.S. Department of Energy by Midwest Research Institute • Battelle • Bechtel

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NREL Solar Atlas

- Http://www.nrel.gov/gis
- Currently includes 48 contiguous states of the US.
- Alaska and Hawaii will be added in the near future.

Goals of NREL Solar Atlas

- Deliver basic solar performance estimates to general users.
- Deliver a wide variety of additional information to more advanced users.
- Be easy to use, full featured, and extensible.

Components of NREL Solar Atlas

- Solar resource datasets from NREL Solar Resource Assessment function and other sources.
- Internet Map Server technology from ESRI ™ including political and infrastructure data coverages.
- Links to Renewable Resource Data Center (rredc.nrel.gov) for supplemental documentation and datasets.

Typical Solar Atlas Users

Same users who currently use the Solar Radiation Data Manual for Flat-Plate and Concentrating Collectors

Need to estimate performance for any of 14 different solar collectors, for any location, for any month and annually.

Include PV sellers, homeowners, as well as researchers and analysts (scientists, students, engineers)

NREL Solar Radiation Products

- National Solar Radiation Data Base (NSRDB) -U. S. only, 30 year time series, measured and modeled radiation.
- NSRDB derived products - Solar collector manual, buildings manual, TMYs.
- **Solar Radiation Data Grids**

NREL Solar Radiation Data Grid

- Uses CSR (Climatological Solar Radiation) model devised by Dr. Gene Maxwell.
- Produces monthly and annual estimates of the daily radiation for each of 14 different solar collector orientations (patterned after NREL “Red Book”).
- **Estimated uncertainty of annual estimates is 11%.**

Fixed Flat-Plate Collectors

- Flat-Plate Collector Facing South at Fixed Tilt=0
- Flat-Plate Collector Facing South at Fixed Tilt=Latitude-15
- Flat-Plate Collector Facing South at Fixed Tilt=Latitude
- Flat-Plate Collector Facing South at Fixed Tilt=Latitude+15
- Flat-Plate Collector Facing South at Fixed Tilt=90

Tracking Flat-Plate Collectors

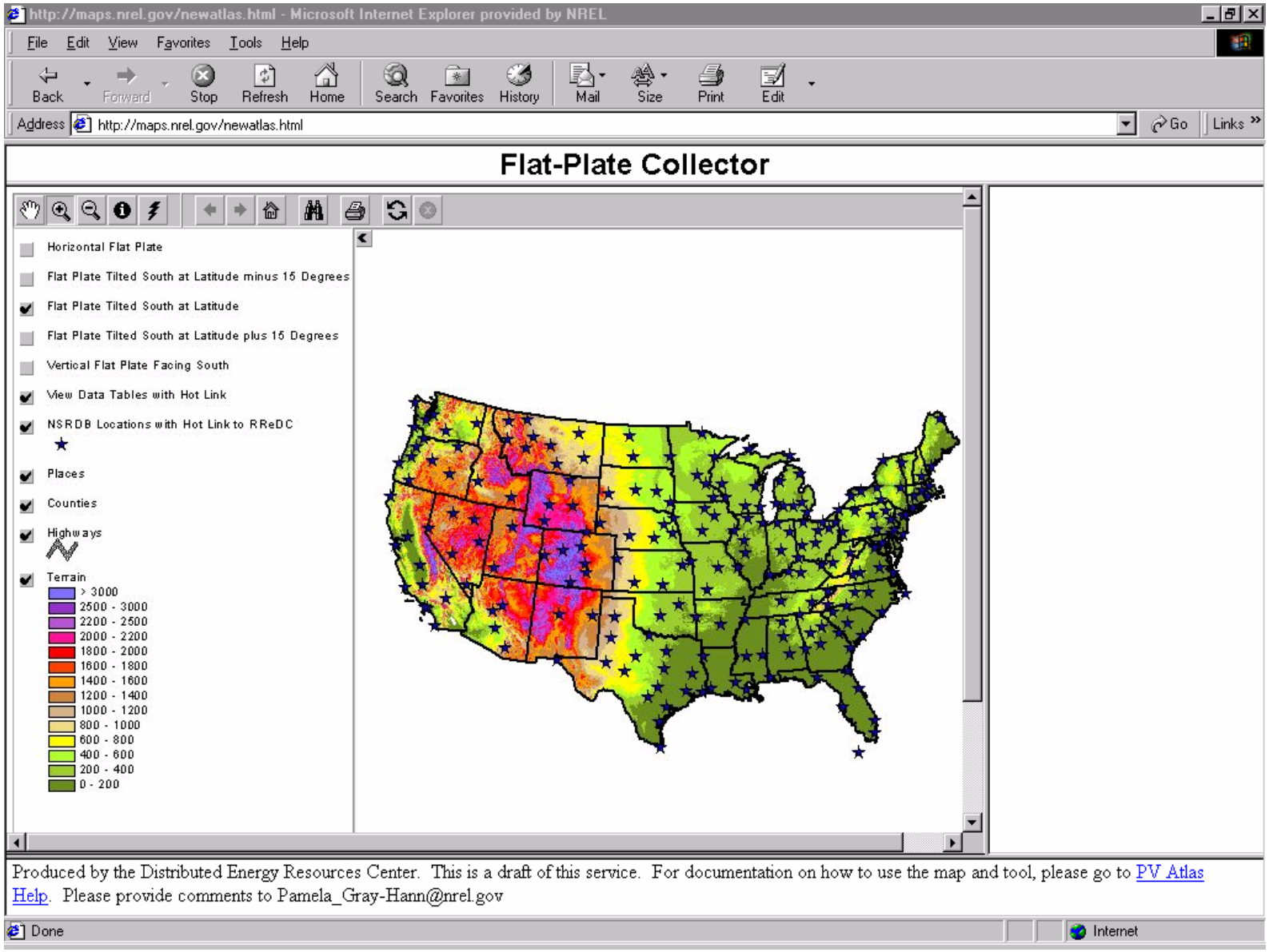
- 1-Axis Tracking Flat-Plate Collector with North-South Axis, Axis Tilt=0
- 1-Axis Tracking Flat-Plate Collector with North-South Axis, Axis Tilt=Latitude-15
- 1-Axis Tracking Flat-Plate Collector with North-South Axis, Axis Tilt=Latitude
- 1-Axis Tracking Flat-Plate Collector with North-South Axis, Axis Tilt=Latitude+15
- 2-Axis Tracking Flat-Plate Collector

Tracking Concentrating Collectors

- 1-Axis Tracking Concentrating Collector with East-West Horizontal Axis
- 1-Axis Tracking Concentrating Collector with North-South Horizontal Axis
- 1-Axis Tracking Concentrating Collector with North-South Axis, Axis Tilt=Latitude
- 2-Axis Tracking Concentrating Collector

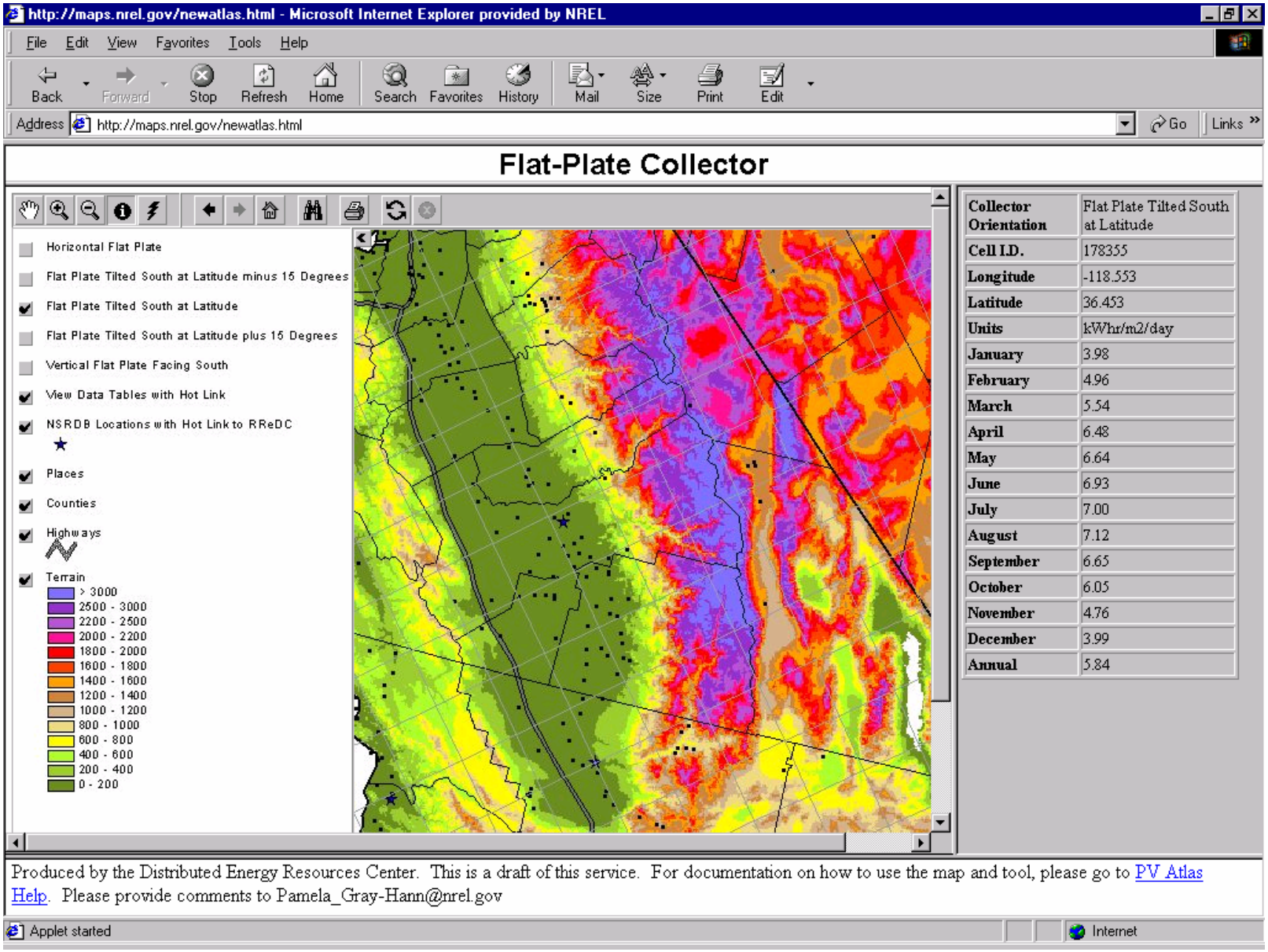
PV Atlas - Map GUI Features

- U.S. Map with terrain overlay, states, NSRDB sites.
- Legend window with 7 data selections (5 individual collectors, Data Grid spreadsheets, NSRDB spreadsheets).
- Multiple navigation aids (terrain, counties, cities, and highways).
- Variable size data retrieval window with file download capability.
- Map navigation and data retrieval toolbar.


http://maps.nrel.gov/newatlas.html - Microsoft Internet Explorer provided by NREL
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Mail Size Print Edit
Address http://maps.nrel.gov/newatlas.html
Go Links
Flat-Plate Collector
Horizontal Flat Plate
Flat Plate Tilted South at Latitude minus 15 Degrees
Flat Plate Tilted South at Latitude
Flat Plate Tilted South at Latitude plus 15 Degrees
Vertical Flat Plate Facing South
View Data Tables with Hot Link
NSRDB Locations with Hot Link to RReDC
Places
Counties
Highways
Terrain
> 3000
2500 - 3000
2200 - 2500
2000 - 2200
1800 - 2000
1600 - 1800
1400 - 1600
1200 - 1400
1000 - 1200
800 - 1000
600 - 800
400 - 600
200 - 400
0 - 200
Produced by the Distributed Energy Resources Center. This is a draft of this service. For documentation on how to use the map and tool, please go to PV Atlas Help. Please provide comments to Pamela_Gray-Hann@nrel.gov
Done
Internet

Single Collector Data Retrieval

- Zoom into your desired area until grey cell outlines appear.
- Select one of 5 collector types in legend window (Tilt=Latitude is the default).
- Select “Data Identity” tool.
- Choose any desired cell with the mouse.
- Monthly and annual radiation for the collector appears in data window on right side of screen.


http://maps.nrel.gov/newatlas.html - Microsoft Internet Explorer provided by NREL
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Flat-Plate Collector
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Flat Plate Tilted South at Latitude minus 15 Degrees
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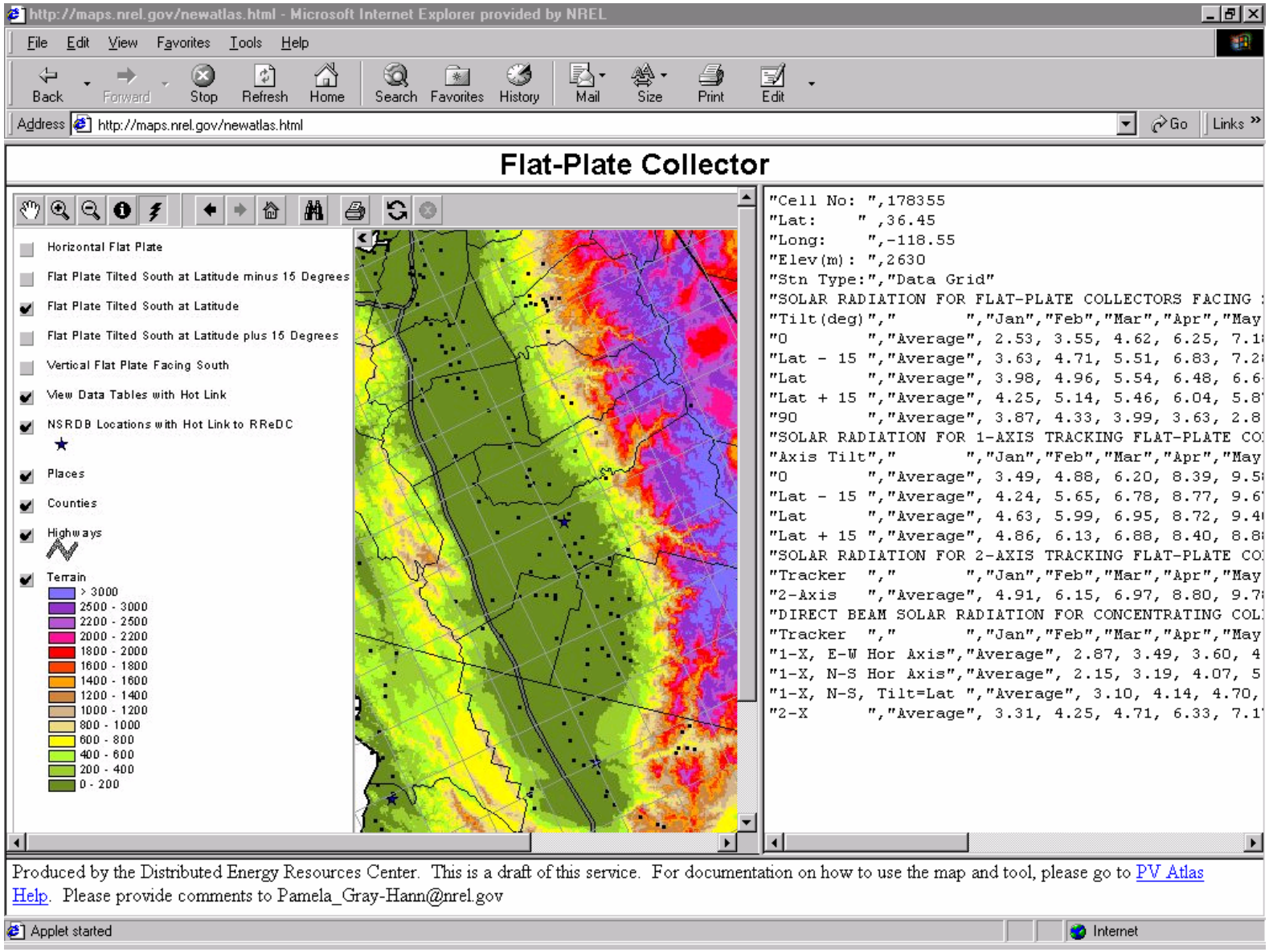
NSRDB Locations with Hot Link to RReDC
Places
Counties
Highways
Terrain
> 3000
2500 - 3000
2200 - 2500
2000 - 2200
1800 - 2000
1600 - 1800
1400 - 1600
1200 - 1400
1000 - 1200
800 - 1000
600 - 800
400 - 600
200 - 400
0 - 200
Collector Orientation | Flat Plate Tilted South at Latitude
Cell I.D. | 178355
Longitude | -118.553
Latitude | 36.453
Units | kWhr/m2/day
January | 3.98
February | 4.96
March | 5.54
April | 6.48
May | 6.64
June | 6.93
July | 7.00
August | 7.12
September | 6.65
October | 6.05
November | 4.76
December | 3.99
Annual | 5.84
Produced by the Distributed Energy Resources Center. This is a draft of this service. For documentation on how to use the map and tool, please go to PV Atlas Help. Please provide comments to Pamela_Gray-Hann@nrel.gov
Applet started
Internet

14 Collector Spreadsheet Data Table Retrieval

- Zoom into your desired area until grey cell outlines appear.
- Select ‘View Data Tables with Hotlink” in the legend.
- Select “Hotlink” tool.
- Choose any desired cell with the mouse.
- Spreadsheet data table with monthly and annual radiation for all 14 collectors appears in data window on right side of screen.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1800 - 2000
1600 - 1800
1400 - 1600
1200 - 1400
1000 - 1200
800 - 1000
600 - 800
400 - 600
200 - 400
0 - 200
"Cell No: ",178355
"Lat: ",36.45
"Long: ",-118.55
"Elev(m): ",2630
"Stn Type:","Data Grid"
"SOLAR RADIATION FOR FLAT-PLATE COLLECTORS FACING
"Tilt(deg)","","Jan","Feb","Mar","Apr","May
"0","Average", 2.53, 3.55, 4.62, 6.25, 7.1
"Lat - 15","Average", 3.63, 4.71, 5.51, 6.83, 7.2
"Lat","Average", 3.98, 4.96, 5.54, 6.48, 6.6
"Lat + 15","Average", 4.25, 5.14, 5.46, 6.04, 5.8
"90","Average", 3.87, 4.33, 3.99, 3.63, 2.8
"SOLAR RADIATION FOR 1-AXIS TRACKING FLAT-PLATE CO
"Axis Tilt","","Jan","Feb","Mar","Apr","May
"0","Average", 3.49, 4.88, 6.20, 8.39, 9.5
"Lat - 15","Average", 4.24, 5.65, 6.78, 8.77, 9.6
"Lat","Average", 4.63, 5.99, 6.95, 8.72, 9.4
"Lat + 15","Average", 4.86, 6.13, 6.88, 8.40, 8.8
"SOLAR RADIATION FOR 2-AXIS TRACKING FLAT-PLATE CO
"Tracker","","Jan","Feb","Mar","Apr","May
"2-Axis","Average", 4.91, 6.15, 6.97, 8.80, 9.7
"DIRECT BEAM SOLAR RADIATION FOR CONCENTRATING COL
"Tracker","","Jan","Feb","Mar","Apr","May
"1-X, E-W Hor Axis","Average", 2.87, 3.49, 3.60, 4
"1-X, N-S Hor Axis","Average", 2.15, 3.19, 4.07, 5
"1-X, N-S, Tilt=Lat","Average", 3.10, 4.14, 4.70,
"2-X","Average", 3.31, 4.25, 4.71, 6.33, 7.1
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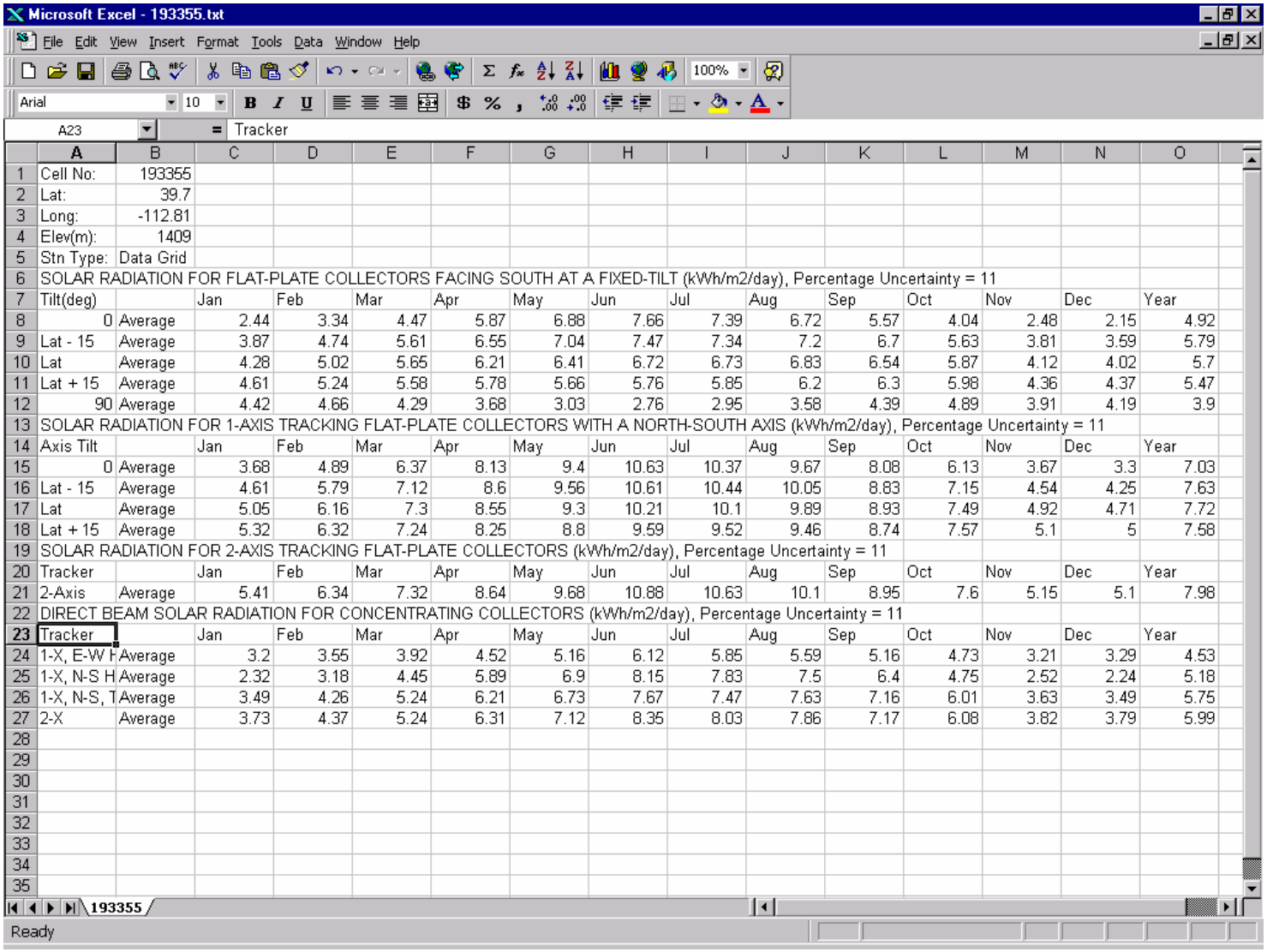
Applet started
Internet

Download Spreadsheet Data Table

- Selected spreadsheet data table appears in data window on right side of screen.
- Select the data window “Frame” with the mouse.
- Choose “File:Save Frame As” on menu.
- File “idno.txt” appears in your directory.
- For Data Grid, idno is a 6 digit cell id.
- For NSRDB, idno is a 5 digit WBAN number.

Spreadsheet Data Table

- Table can be loaded into Excel using Text Import Wizard as a “Delimited” file with “comma” as the delimiter.
- NREL can provide a macro program to load the file into Excel and create graphics for all 14 collectors.



Microsoft Excel - 193355.txt

File Edit View Insert Format Tools Data Window Help

Arial 10 100%

A23 = Tracker

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Cell No:	193355													
2	Lat:	39.7													
3	Long:	-112.81													
4	Elev(m):	1409													
5	Stn Type:	Data Grid													
6	SOLAR RADIATION FOR FLAT-PLATE COLLECTORS FACING SOUTH AT A FIXED-TILT (kWh/m2/day), Percentage Uncertainty = 11														
7	Tilt(deg)		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
8	0	Average	2.44	3.34	4.47	5.87	6.88	7.66	7.39	6.72	5.57	4.04	2.48	2.15	4.92
9	Lat - 15	Average	3.87	4.74	5.61	6.55	7.04	7.47	7.34	7.2	6.7	5.63	3.81	3.59	5.79
10	Lat	Average	4.28	5.02	5.65	6.21	6.41	6.72	6.73	6.83	6.54	5.87	4.12	4.02	5.7
11	Lat + 15	Average	4.61	5.24	5.58	5.78	5.66	5.76	5.85	6.2	6.3	5.98	4.36	4.37	5.47
12	90	Average	4.42	4.66	4.29	3.68	3.03	2.76	2.95	3.58	4.39	4.89	3.91	4.19	3.9
13	SOLAR RADIATION FOR 1-AXIS TRACKING FLAT-PLATE COLLECTORS WITH A NORTH-SOUTH AXIS (kWh/m2/day), Percentage Uncertainty = 11														
14	Axis Tilt		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
15	0	Average	3.68	4.89	6.37	8.13	9.4	10.63	10.37	9.67	8.08	6.13	3.67	3.3	7.03
16	Lat - 15	Average	4.61	5.79	7.12	8.6	9.56	10.61	10.44	10.05	8.83	7.15	4.54	4.25	7.63
17	Lat	Average	5.05	6.16	7.3	8.55	9.3	10.21	10.1	9.89	8.93	7.49	4.92	4.71	7.72
18	Lat + 15	Average	5.32	6.32	7.24	8.25	8.8	9.59	9.52	9.46	8.74	7.57	5.1	5	7.58
19	SOLAR RADIATION FOR 2-AXIS TRACKING FLAT-PLATE COLLECTORS (kWh/m2/day), Percentage Uncertainty = 11														
20	Tracker		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
21	2-Axis	Average	5.41	6.34	7.32	8.64	9.68	10.88	10.63	10.1	8.95	7.6	5.15	5.1	7.98
22	DIRECT BEAM SOLAR RADIATION FOR CONCENTRATING COLLECTORS (kWh/m2/day), Percentage Uncertainty = 11														
23	Tracker		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
24	1-X, E-W H	Average	3.2	3.55	3.92	4.52	5.16	6.12	5.85	5.59	5.16	4.73	3.21	3.29	4.53
25	1-X, N-S H	Average	2.32	3.18	4.45	5.89	6.9	8.15	7.83	7.5	6.4	4.75	2.52	2.24	5.18
26	1-X, N-S, T	Average	3.49	4.26	5.24	6.21	6.73	7.67	7.47	7.63	7.16	6.01	3.63	3.49	5.75
27	2-X	Average	3.73	4.37	5.24	6.31	7.12	8.35	8.03	7.86	7.17	6.08	3.82	3.79	5.99
28															
29															
30															
31															
32															
33															
34															
35															

193355

Ready

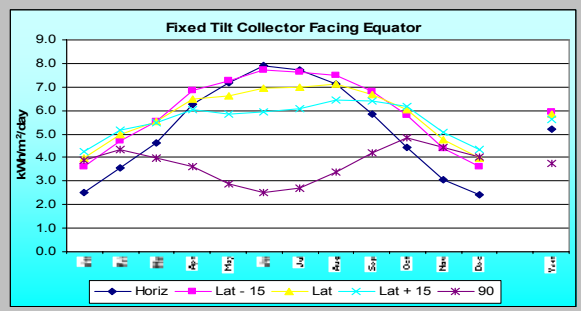
Data Table - Excel Graphics

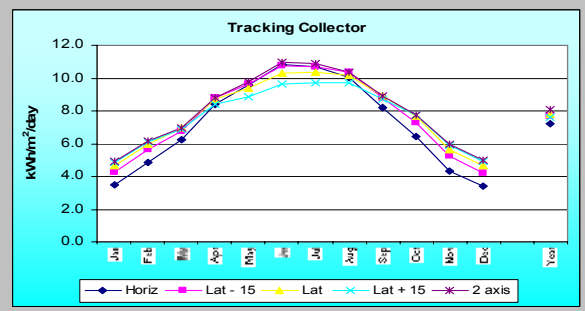
Solar Radiation Data for Flat-Plate and Concentrating Collectors

Cell No: 178355

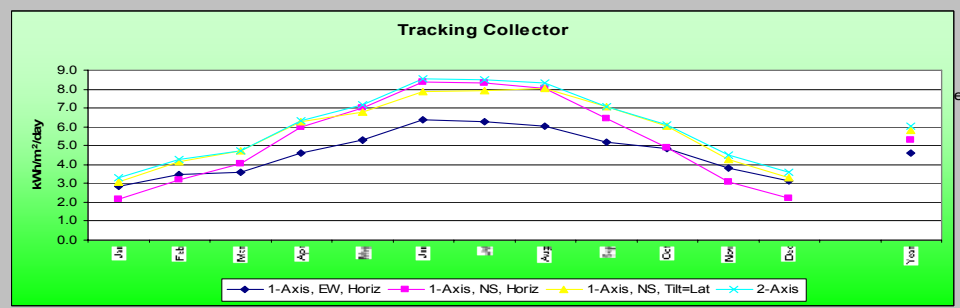
Lat: 36.45
Long: -118.55
Elev(m): 2630
Stn Type: Data Grid

Average Solar Radiation for Flat Plate Collectors





Average Direct Beam Solar Radiation for Concentrating Collectors



Developed by the National Renewable Energy Laboratory

PV Atlas - (near) future enhancements

- Alaska and Hawaii
- Two more map interfaces, one for Tracking Flat Plates and one for Tracking Concentrators.
- Maps of the solar resource.
- Map interface to various sources of solar radiation data (CONFFRM, BSRN, WRDC, etc.)